



DATE: August 20, 2001

SUBJECT: Understanding Natural Gas Hydrates Seminar October 2001

TO: Professionals who Need to Expand their Knowledge of Natural Gas Hydrates

Would you like to have a better understanding of natural gas hydrates? EnhanceCo, Inc. has teamed up with Dr. John Carroll of Gas Liquids Engineering, Ltd. to offer an *intensive one-day seminar*.

**This seminar will cover the following topics.**

1. Natural gas hydrates formation and inhibition demonstrations.
2. Practical application of natural gas hydrates calculation methods.
3. Discussions about various software calculation programs and the efficiency of their calculation methods
4. Videos from recent news stories regarding natural gas hydrates

A comprehensive manual that contains, practical working examples, current reference data, and details of calculation methods is included with the seminar.

If you have any questions, please call Tom Pickthall, at (281)499-4426 or by email at [twp@enhanceco.net](mailto:twp@enhanceco.net).

Thank you, and I'm looking forward to hearing from you.

Sincerely,

**Tom Pickthall**

Tom Pickthall

## Included in the course are:

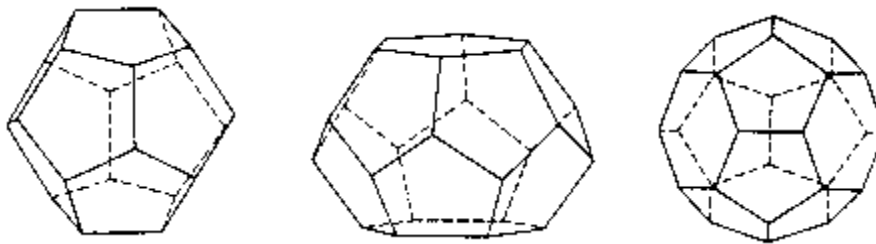
- ✍ Demonstrations of hydrate formation and inhibition
- ✍ Brief videos from recent news stories regarding hydrates
- ✍ Effective calculation methods that have practical application in working with hydrates
- ✍ Discussions about various software calculation programs and the efficiency of their calculation methods
- ✍ A comprehensive manual that includes practical working examples, current reference data, and details of calculation methods

## About the instructor...

**John Carroll**, the instructor for the course and author of the manual, obtained his Ph.D. in Chemical Engineering in 1990 at the University of Alberta in Edmonton, Alberta, Canada. Until 1993, he was a Research Associate and Sessional Lecturer at the university, teaching heat transfer and numerical analysis. In addition he worked on several research projects relevant to the natural gas industry. He has authored or co-authored more than 30 papers in refereed journals, 10 articles in technical magazines, and approximately 25 conference presentations.

He is a registered professional engineer in the Province of Alberta and is associated with several chemical and engineering associations including The Canadian Society for Chemical Engineering (CSChE) and The Canadian Gas Processors Supply Association (CGPSA). He is also on the publication committee of the CSChE.

Dr. Carroll is the Manager of Simulation Services and Technology Development at Gas Liquids Engineering in Calgary, Alberta. At GLE he has worked on a variety of projects, which included natural gas sweetening, hydrocarbon processing, acid gas injection, and fluid phase equilibrium. He is the instructor for several courses offered by Technical Training Services.



# UNDERSTANDING NATURAL GAS HYDRATES

- What *is* a hydrate?
- What compounds form hydrates?
- What are the physical properties of hydrates?
- Under what conditions of temperature and pressure do they form?
- What problems do they cause?
- What can be done about them?

*Learn the answers to these and many other questions in this one-day course offered by:*

**EnhanceCo, Inc.**  
2714 Cypress Point Drive, Suite E  
Missouri City, Texas 77459  
Phone: 281-499-4426  
Fax: 281-261-5617  
e-mail: [rust@enhanceco.net](mailto:rust@enhanceco.net)  
[www.enhanceco.net](http://www.enhanceco.net)

**This intensive course is for engineers and scientists who must contend with gas hydrates. The following topics will be discussed:**

### 1. The water molecule and the hydrogen bond

- > *Why water is different?*
  - boiling point
  - enthalpy of vaporization
  - expansion upon freezing
- > *The structure of ice*

### 2. Hydrate and non-hydrate formers

- Type I
- Type II
- Type H
- > *Structures of hydrates*

### 3. Hydrate compositions

- > *Theoretical composition*
- > *Actual compositions*

### 4. Calculation of hydrate forming conditions

- > *Hand calculation methods*
  - gas gravity method
  - K-factor method

### 5. Advanced calculation methods (software calculations)

- van der Waals and Platteeuw
- Parish and Prausnitz

- Ng and Robinson

### 6. Methods for combating hydrate formation

- > *Chemicals*
  - inhibitors (methanol)
  - Hammerschmidt equation:
 
$$?T ? \frac{1297 W}{M(100 - W)}$$
- > *Heat*
  - line heaters and heat tracing
- > *Dehydration*
  - glycol dehydration
  - refrigeration
  - molecular sieves

### 7. Physical properties of hydrates

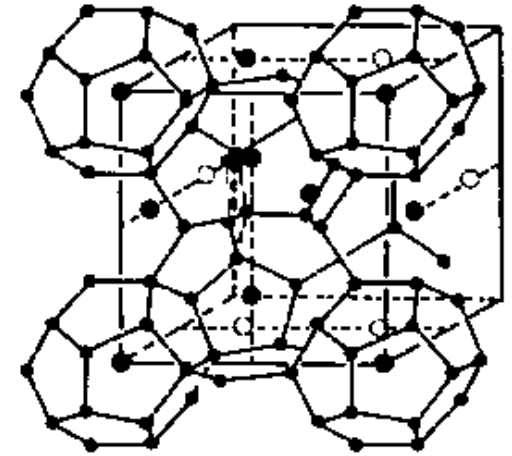
- density
- heat capacity
- heat of formation
- mechanical properties

### 8. Water content of gas

### 9. Joule-Thomson effect

### 10. Use of phase diagrams to understand the subtleties of hydrate formation conditions

- phase loci
- triple points
- quadruple points
- pressure-temperature diagrams
- pressure-composition diagrams
- temperature-composition diagrams



### 11. Natural occurrence of hydrates

This intensive, one-day course will be offered by EnhanceCo. It is conducted through Technical Training Services, a subsidiary of Gas Liquids Engineering Ltd., Calgary, Alberta.

The course will be held in the Houston area during the month of October .

**Cost: \$300.00 (USD) - subject to change without notice**

Please contact us for additional information, especially regarding the dates for upcoming courses.

**Enrollment in the course is limited.**



Return by e-mail: [rust@enhanceco.net](mailto:rust@enhanceco.net)  
Fax: 281-261-5617

Questions? 281-499-4426

### Registration Form

Please type or print legibly:

Mr. \_\_\_ Mrs. \_\_\_ Ms. \_\_\_\_\_

Job Title \_\_\_\_\_

Company \_\_\_\_\_

Company Mailing Address \_\_\_\_\_

\_\_\_\_\_ City State zip

Company Telephone \_\_\_\_\_ FAX \_\_\_\_\_

E-Mail Address \_\_\_\_\_

**Pre Registration: (check all that apply)**

\_\_\_ **\$300 for the course payable to: EnhanceCo, Inc. (U.S. Funds)**

\_\_\_ Card Type (please circle) VISA    Mastercard    Discover    AmEx

\_\_\_ Credit Card # \_\_\_\_\_ Exp. Date \_\_\_\_\_

\_\_\_ Bill my company. A copy of the purchase order or letter of authorization is enclosed.

Participant Signature \_\_\_\_\_ Date \_\_\_\_\_